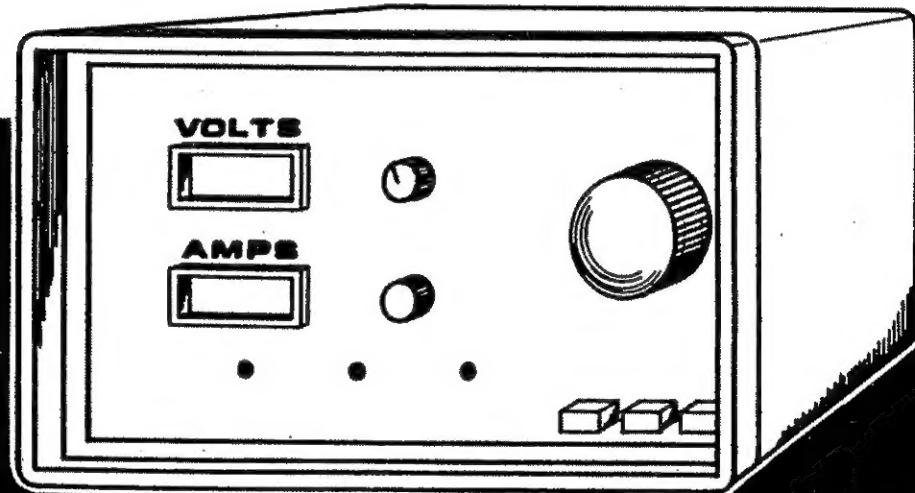


KM5071

ELECTRICAL SYSTEM ANALYZER



OWNERS MANUAL

2-213701

**IMPORTANT OPERATING & SAFETY NOTES...
READ BEFORE PROCEEDING WITH TESTS**

1. Always work in a well ventilated area...Never start a vehicle's engine in an enclosed area.
2. Never smoke or allow any other open flame to come within 25 feet of the vehicle being tested.
3. Always insure that **everyone** within close proximity of the vehicle being tested is **correctly** wearing approved safety/protective glasses before proceeding with any testing or adjustments.
4. Always insure that vehicle's engine is turned OFF when connecting or disconnecting any and all test equipment.
5. Always insure that the tester's black grounding clip is connected first during hook-up, and that it is disconnected **last** when testing is completed.
6. Always exercise **extreme** caution to insure that hands, arms, clothing and tester leads are kept well away from all moving engine parts.
7. Because the battery may produce highly explosive gases, it is extremely important that you carefully observe the following precautions:
 - A. DO NOT allow battery acid or corrosion to come in direct contact with skin or eyes...If it does, thoroughly wash skin with warm, soapy water **IMMEDIATELY** and/or rinse eyes with clear water for 15-20 minutes...**CONTACT PHYSICIAN IMMEDIATELY**.
 - B. Extreme caution must be exercised to avoid ingestion of battery acid or corrosion...If ingestion does occur, drink large quantities of milk (**DO NOT INDUCE VOMITING**). **CONTACT PHYSICIAN IMMEDIATELY**.
8. Battery acid and corrosion can be extremely dangerous and **MUST BE DEALT WITH VERY CAREFULLY**.
 - A. DO NOT allow battery acid or corrosion to come in direct contact with skin or eyes...If it does, thoroughly wash skin with warm, soapy water **IMMEDIATELY** and/or rinse eyes with clear water for 15-20 minutes...**CONTACT PHYSICIAN IMMEDIATELY**.
 - B. Extreme caution must be exercised to avoid ingestion of battery acid or corrosion...If ingestion does occur, drink large quantities of milk (**DO NOT INDUCE VOMITING**). **CONTACT PHYSICIAN IMMEDIATELY**.
9. Tremendous back pressure can be developed in the radiator, and taking the radiator cap off improperly can result in a sudden release of scalding hot water, and subsequent serious burns. You **MUST** refer to proper vehicle manufacturer's service manual for correct procedure.

Due to the inherent dangers associated with even the simplest automotive maintenance procedures, the manufacturer and all parties involved in the distribution and/or sale of this automotive test product will NOT be held liable or responsible, wholly OR partially, for ANY injuries, damages or claims resulting from the performance of testing or adjustment procedures included in this instruction guide and/or the use of this automotive test product.

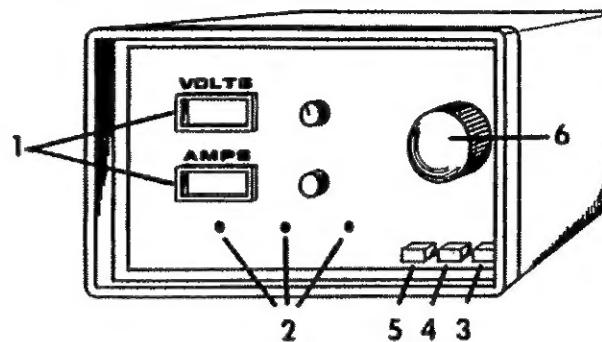
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A. FEATURES AND CONTROLS

The Electric System Analyzer is a precision tool for the professional. It is simple to operate. It is housed in a rugged, 20 Ga. Cold Rolled Steel Case with baked enameled finish. ABS High Impact Plastic Front Panel. All solid state circuit, for heavy duty shop use and testing reliability. Convenient hook-up. All connections are of the simple clip or clamp-on variety.



1. Large LCD Digital Display for easy reading.
2. Three function diodes that light up for:
 - Load applied - indicating when carbon pile load is engaged momentarily or during 15 second battery or cranking test.
 - Charge and retest - will stay lighted if battery voltage is less than 9.6 volts when using the "15 Second Load" for 12V battery load or cranking test.
 - Check Diode - if diode(s) or stator are bad.
3. ON/OFF switch for safety. There is no current draw until switch is depressed to "ON" position. Prevents danger of "sparking" when connecting the battery.
4. Momentary Load Switch - to pre-adjust the carbon pile for battery load or alternator output tests.
5. 15 Second Load Switch - When the button is pushed, it will hold for 15 seconds and then switch off automatically. Use it when:
 - applying the pre-adjust load with the aid of the carbon pile, or
 - performing cranking current draw with the aid of the vehicle's starter motor.
6. Load Control - to adjust the 5000 watt fan cooled carbon pile to the desired load value.

B. GENERAL INFORMATION

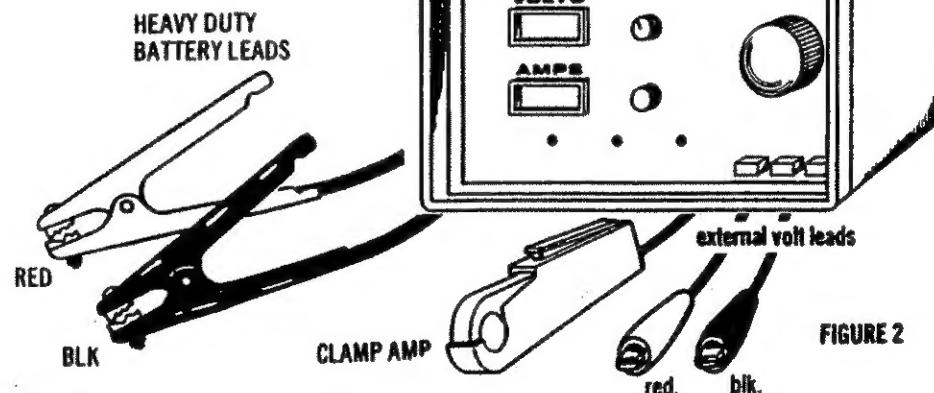


FIGURE 2

1. VOLTMETER

The Voltmeter measures the existence of tension in an electric circuit. It can also be used for voltage drop measurement. The Voltmeter has a range of .0 to 199.9 volts DC.

2. AMMETER

The Ammeter measures current flow in an electrical circuit, such as the charging system, cranking system, head light harness, etc. The Ammeter range is 0-800 Amps.

3. VOLTMETER LEADS SELECTOR SWITCH

When the Selector Switch is in the "Battery Volt" position, the Voltmeter connects to the electric source through a separate set of leads (inside the battery cables) which are directly connected to the heavy duty battery clamps. When the Selector Switch is in the "External Volt" position, the voltmeter is connected to the source through the 2 external voltmeter leads.

4. AMMETER "ZERO" ADJUST

The Ammeter must be "Zero Adjust" before the "Amp Clamp-on" is connected to the circuit to be tested. If "Zero Adjust" is omitted, Ammeter reading will not be accurate.

5. HEAVY DUTY BATTERY CABLES

When the cables are connected to the Battery (observe polarity)

- Power is supplied to the tester by pushing the ON/OFF button to ON.
- Volt and Amp readings will be on display.

6. AMP CLAMP-ON

Once the Ammeter has been "Zero Adjust" connect the "Clamp-on" as follows:

- To perform "Battery Load Test" - to the retainer sleeve around the negative cable in back of the Analyzer (see Fig. 2) Connect with NEG-ARROW pointing toward battery.
- When making "Starter Motor Current Draw" or "Charging System Output Test" - to either of the vehicles' battery cable, the arrow on the "Clamp-on" must agree with the polarity (NEG or POS) of the battery terminal.

7. EXTERNAL VOLT LEADS

To measure voltage values across sources other than the battery or to make "Voltage drop" tests, use the "External Volt Leads" (Check position of Voltmeter Leads Selector Switch.)

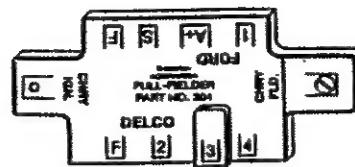
8. FULL FIELDER ALTERNATOR ADAPTERS

When there is no output from the charging system and to check if the malfunction is caused by the voltage Regulator or the Alternator, select the adapter for the application from the set supplied with the Analyzer (see listing and identification below). Disconnect the plug at the Regulator and substitute with respective adapter. Follow the testing procedures as explained on page 13 of this instruction manual.

9. SIDE TERMINAL ADAPTERS (Fig. 3)

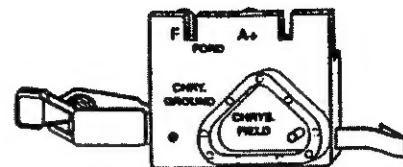
Use them on batteries with threaded top or side connections to provide a suitable connection for the heavy duty battery cables.

304

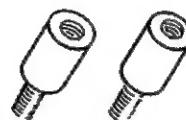


**Full-Fielder
Alternator Test Adapter**

342



**Full-Fielder II
Alternator Test Adapter**



**Battery
Side
Terminals
Adapters**

Fig. 3

C. BATTERY MAINTENANCE PROCEDURES

Battery capacity is affected by temperature, specific gravity of battery fluid, state of charge, age of battery, etc. Following are some of the basics of battery checking:

- Visual inspection
- Specific gravity of electrolyte measurement
- Battery load capacity

CAUTION: When working on batteries care should be taken to:

1. Wear safety glasses.
2. Do not break live circuits at the battery terminals.
3. Avoid accidentally shorting the charger or analyzer clips to the engine frame when connecting and disconnecting the battery leads.
4. Remove the surface charge by applying the rated Amp load across the battery terminals for 10 seconds or by turning on the head lights for 2 minutes. This stabilizes the battery's state of charge at its normal operating level.

1. VISUAL INSPECTION AND SPECIFIC GRAVITY TESTS

a. All Types of Batteries

- Batteries must be kept clean to avoid self-discharge. Clean battery periodically with a solution of baking powder diluted in water.

CAUTION: Vent caps must be securely fastened to avoid cleaning solution from leaking or dripping inside the battery and contaminating the electrolyte.

- Keep battery posts and cable terminals free from corrosion.
- Check for loose battery post connections.
- Check that battery case is not damaged, allowing electrolyte to leak out.

b. "Open Vent" type batteries

- Check the electrolyte level inside the battery cells. Make sure that all plates are covered and fluid is up to recommended level.
- Only use "Distilled Water" when adding water to the cells. DO NOT use tap water.
- Use hydrometer to check specific gravity readings. The specific gravity readings should not vary more than 50 points between cells. If the variance is more than 50 points, replace the battery.
- The specific gravity should be at least 1.230 (Check battery manufacturer's specs for specific gravity readings other than 74°F/24°C temperature.) If not, charge the battery until 1.230 is obtained. In case the battery is in a very low state of charge, a longer period of charging may be required. After charging, remove the surface charge from the battery. If charging the battery will not up the reading to 1.230, the battery should be replaced.

c. Maintenance free and sealed batteries

- Check "state of charge" indicator on the cover of the battery. The meaning of the color bands appearing on the indicator is:
 - GREEN - The battery should be in a fully charged condition.
 - BLACK - (dark) The battery is partially discharged.
 - YELLOW - The battery is low on fluid and is near the end of its useful life. DO NOT attempt to recharge or test the battery if yellow appears on indicator.

D. BATTERY CAPACITY OR STATE OF CHARGE RATINGS

Battery manufacturers have used different methods to rate the capacity of their batteries. Following are 3 of the methods used:

1. AMP/HRS RATING

For years batteries were rated in ampere/hours. The recommended capacity test was based on applying a load in amperes of 3 times the Amp/hrs. rating. In the case of a 50 Amp/hrs. rated battery the load would be 150 Amps.

2. COLD CRANKING AMPS

The approach of battery testing takes into consideration the size of the engine and the anticipated load on the battery in Amps to crank it at 0°F (-18°C) ambient temperature. To start an engine at that temperature it requires one Amp output from a 12 volt battery for every cubic inch displacement. For example: a 350 cu. in. engine would require a battery rated at 350 cold cranking Amps capacity. At 70°F (21°C) ambient temperature the same engine should require only half the "Cold Cranking Amps" to start it. The recommended load to test the battery in 70°F (21°C) or higher tempered ambient would be 175 Amps. Make sure that the battery being tested agrees with the size of the engine and rating specified by the vehicle manufacturer.

3. BATTERY WATTS RATING

Some battery manufacturers use Watts Rating instead of the "Cold Cranking Amps" approach mentioned above. Watts is a composite of amps and volts. For instance: a 5000 peak-watts rated battery, would be equivalent to a 420 ($5000 \div 12 = 420$) "Cold Cranking Amps" rated battery. When capacity testing the battery in a 70°F (21°C) ambient, the load for testing it would be $\frac{1}{2}$ the "Cold Cranking Amps" value, or 210 Amps.

E. BATTERY LOAD OR CAPACITY TESTS

A battery must be tested under load. Specific gravity or open circuit voltage tests do not reflect the actual battery condition. To conclude that a battery is in good condition and that it will have the capability of starting an engine in sub-zero temperatures or when overheated and tight, requires an electric load test that will duplicate such conditions in the shop. The following two testing approaches are used and accepted by the industry.

1. LOAD TEST BY CRANKING ENGINE

Use starter motor and the load of the engine to draw current from the battery for 15 second continuous cranking. The Cranking Load Test determines whether the battery is suitable and in good condition to operate the starter system, and also checks the condition of the cables, solenoid, starter motor, etc. and if sufficient voltage is delivered to the ignition system to start the engine.

a. PREPARING ENGINE AND ANALYZER FOR TEST

1. The ignition and all accessories should be off.
2. Turn "Volt Lead" selector to "Battery" position.
3. Turn "Load Control" knob fully CCW (counterclockwise).
4. "ON/OFF" button must be in "OFF" (yellow).
5. Connect "Battery Cables" to battery as shown in Fig. 4.
6. Push "ON/OFF" button to "ON" (green).
7. Adjust ammeter reading with "zero adjust" control to "0.000".
8. Connect "Amp Clamp-on" to either the positive (car's electrical installation) or negative (car's ground cable or strap) battery cable, observing that the clamp is connected in such a way that the arrow on the clamp points to the respective positive or negative terminal of the battery.
9. Prevent engine from starting by either:
 - a. disconnecting the high tension wire from the center tower of the distributor and connecting it to ground or,
 - b. disconnect the ignition switch lead from the primary terminal of the coil.

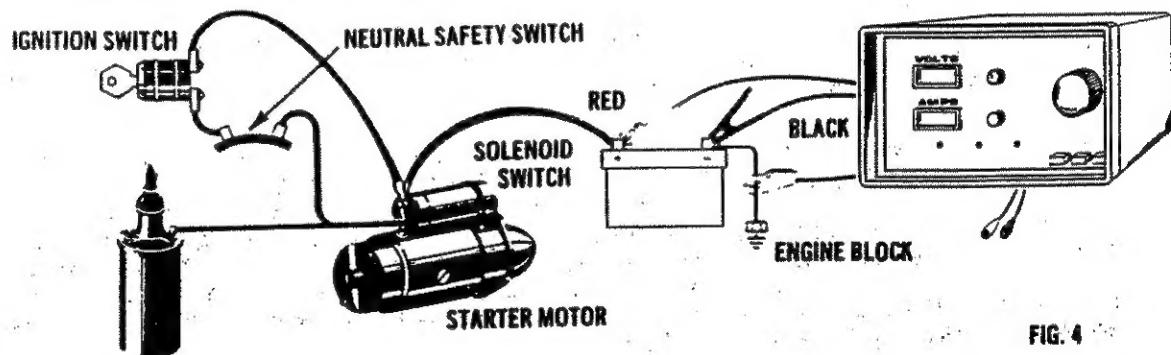


FIG. 4

10. Refer to Table 1 to establish the correct "Battery Temperature/Voltage" value.
11. Crank engine for 15 seconds. Use the "15 Second Load" button as a timer. (Make sure that "Load Control" is turned fully CCW as per No. 3 above).
12. While engine is cranking, observe the Amps and Volts readings, and make sure that:
 - The cranking amperage is within:
 - 100-125A for 4 Cyl. Engine
 - 125-175A for 6 Cyl. Engine
 - 175-250A for 8 Cyl. Engine
 - Or as specified by car manufacturer
 - voltage is not less than specified in Table 1 above, at any time during the 15 second test.

TABLE 1 - BATTERY TEMPERATURE/VOLTAGE VALUE

(21°C) 70°F & ABOVE	(16°C) 60°F	(10°C) 50°F	(4°C) 40°F	(-1°C) 30°F	(-7°C) 20°F	(-12°C) 10°F	(-18°C) 0°F
9.6	9.5	9.4	9.3	9.1	8.9	8.7	8.5

PLEASE NOTE: If the reading at the end of the "15 Second" test is below 9.6 volts and the battery temperature is above 70°F (21°C), the lighted "Charge and Retest Light" will automatically indicate that the battery failed the load test. Charge the battery and retest to make sure that the battery was good, but in low state of charge or to confirm that the battery is not good. If the battery temperature is below 70°F (21°C), refer to Table 1, to find the "Minimum Voltage" acceptable. The battery may be in good condition even though the "Charge and Retest" light is on.

13. Compare possible causes/malfunctions in Table 2:

TABLE 2 - STARTING SYSTEM TROUBLE SHOOTING CHART - 12 VOLT SYSTEM

STARTING SYSTEM TEST RESULTS			PROBABLE CAUSES	SUGGESTIONS SOLUTIONS
VOLTS	AMPS	SPEED		
ABOVE 9.6	NORMAL	NORMAL	START'G SYST. GOOD COND.	
ABOVE 9.6	LOW	SLOW	-HIGH RESIST. -PARTIALLY BROKEN CABLES, WIRES -BAD SOLENOID -BAD GROUND	-VOLTAGE DROP TEST -CHECK BATT. CABLES, TERMINALS -SOLEN. CONTACTS -BY-PASS CIRC.
ABOVE 9.6 (HIGH)	LOW	NORMAL (TO HIGH)	-ENGINE COMPRESSION LOW	-CYL. BAL. TEST -COMPR. TEST
BELOW 9.6	NORMAL-TO LOW	SLOW (NORMAL)	-DISCH. BATTERY -BAD BATTERY	-BATT LOAD TEST -CHARGE & RET. -CHECK CHARG'G SYSTEM -AMBIENT TEMPERATURE BELOW 70°F (21°C)
BELOW 9.6	NORMAL-TO HIGH	SLOW	-COLD OR OVER HEATED ENGINE -STARTER PROBLEM	-ALLOW ENGINE TO NORMALIZE -CHECK STARTER
BELOW 9.6	NORMAL-TO HIGH	FLUCTUATING	-STARTER BAD -UNBALANCED ENGINE	-CHECK STARTER -CYL. BAL. TEST ENGINE
BELOW 9.6	LOW	-NO STARTER -SOLENOID CLICKS	-OXIDIZED BATT. TERMINAL/POSTS	-CLEAN/SCRAPE POSTS/TERM.

2. LOAD TEST WITH ANALYZER LOAD

By using the carbon pile facilities of the Analyzer, it can be pre-programmed in accordance with the Manufacturer's Specified Battery Capacity Rating in Amps.
The Battery can be tested by itself or installed in the car.

a. PREPARING ANALYZER (AND ENGINE) FOR TEST

1. The ignition and all accessories should be off.
2. Turn "Volt Load" selector to "Battery" position.

3. Turn "Load Control" knob fully CCW (counterclockwise).
4. "ON/OFF" button must be in "OFF" (yellow).
5. Connect "Battery Cables" to Battery as shown in figure 5.

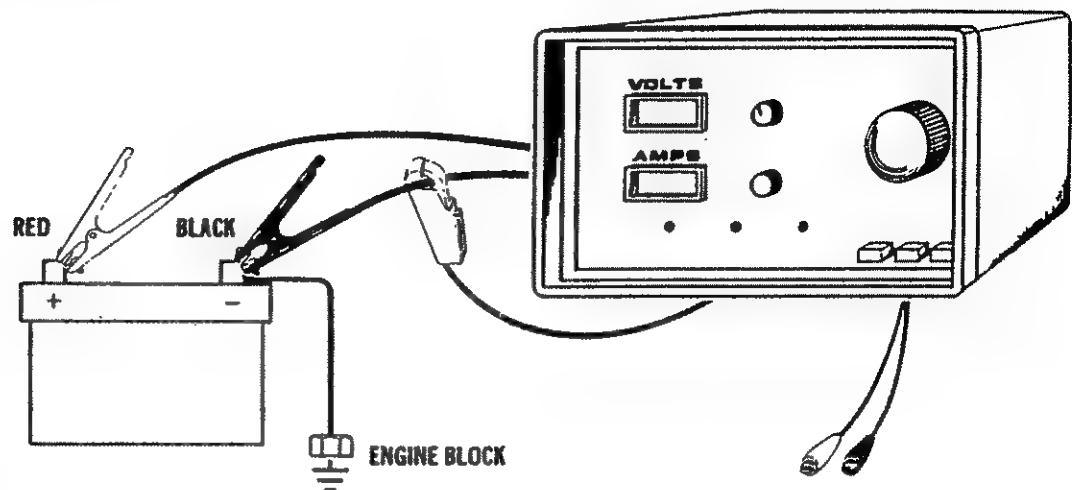


FIG. 5

6. Push "ON/OFF" button to "ON" (green).
7. Adjust Ammeter reading with "Zero Adjust" control to "0.000".
8. Connect "Amp Clamp-on" to negative battery lead spacer in rear of tester with negative pointer on Clamp-on toward the battery.
9. Refer to Table 1 page 9, to establish the correct Battery Temperature/Voltage Value when loading the battery.
10. Refer to Capacity Rating on Battery or check Battery or Car Manufacturer specification for the Battery type of Car model being tested. (see explanation under "D-BATTERY CAPACITY OR STATE OF CHARGE RATING", page 7)
11. Push "Momentary Load" button and turn "Load Control" knob CW (clockwise) until the desired load value in ampere is reached. Release button.
12. Push the "15 Second Load" button and observe volt meter reading.
13. "Charge and Retest" indicator light will come "ON" whenever voltage at the end of a 15 second test is less than 9.6 volts when testing a 12V system.

PLEASE NOTE: If the reading at the end of the "15 second test" is below 9.6 volts and the battery temperature is above 70°F (21°C), the lighted "Charge and Retest Light" will automatically indicate that the battery failed the load test. Charge the battery and retest to assure that the battery was good, but in low state of charge or to confirm that the battery is not good.

If the battery temperature is below 70°F (21°C), refer to Table 1, to find the "Minimum Voltage" acceptable. The battery may be in good condition even though the "Charge and Retest" light is on.

CHARGING SYSTEMS

1. PRELIMINARY INFORMATION

The charging system provides the electrical energy needed to recharge the battery, operate the ignition system, lights, radio, air conditioner and any other equipment that requires power...while the engine is running. The system consists of the alternator (or generator), regulator, battery and all the wires and leads that connect these components to the rest of the engine's electrical system.

If the charging system is operating properly, the voltage and current required by the engine and all its accessories is demand regulated at all times. The alternator (or generator) supplies the engine's direct energy needs and also maintains the battery fully charged. The battery provides reserve power when the alternator can't supply all the energy required (when the engine is idling, for example). It also insures that adequate electrical reserve will be available to restart the engine. The regulator acts as the "brains" of the system by regulating the field excitation of the generator or alternator, and at the same time insures that the voltage is controlled to avoid damage to components or cause over-heating of the battery. Each of the charging system's components play an important role in the engine's efficient operation, and if any one of these components is not performing satisfactorily, there will be a problem. The tests in this section will quickly and easily determine whether or not the charging system is operating properly and help pinpoint any problem that may exist.

2. CHARGING SYSTEM TESTING

Most cars on the road today are equipped with Alternators instead of Generators. Both fulfill the same purpose. The Alternator has the advantage that the output to weight ratio is greatly improved, it has a limited output even while the engine is idling. Output and Voltage regulation has been simplified.

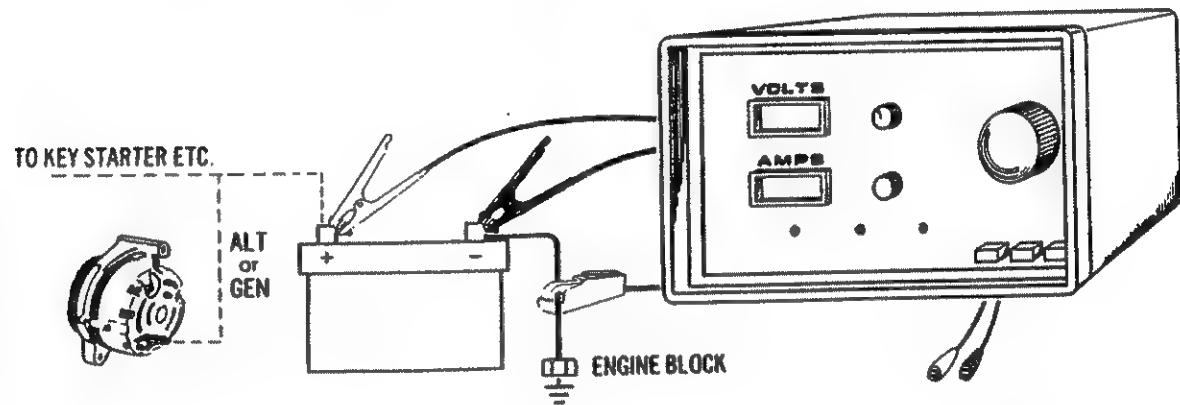


FIG.6

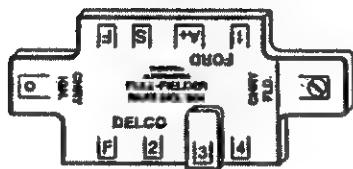
a. ALTERNATOR/VOLTAGE REGULATOR OUTPUT TEST

1. Turn "Volt Lead" selector to "Battery" position.
2. Turn "Lead Control" knob fully CCW (counterclockwise)
3. "ON/OFF" button must be in "OFF" (yellow)
4. Connect "Battery Leads" to battery as shown in figure 6 above.
5. Push "ON/OFF" button to "ON" (green).
6. Adjust ammeter reading with "Zero Adjust" control to "0.000".
7. Connect "Amp Clamp-on" to either the positive (car's electrical installation) or negative (car's ground cable or strap) battery cable, observing that the clamp is connected with the arrow on the clamp pointing to the respective positive or negative terminal of the battery.
8. Start engine and increase engine speed to 2000 rpm.

9. Push "Momentary Load" button and turn "Load Control" CW (clockwise) until the voltage reading is 12 volts in a 12 volt system.
10. Observe amp reading and compare it with manufacturer's specs or with information given on alternator. If output is not obtained, increase rpm to 2500 and repeat tests 9 and 10. Certain late model cars have the heater/air conditioner blower connected directly to the alternator output and operate when engine is running. When checking alternator output on these vehicles either:
 - Add 10 amps to the charging rate shown on the meter, or
 - Disconnect the heater/air conditioning motor blower lead and read the actual alternator output on the meter.
11. Make sure that the "Check Diode" light stays OFF.
12. Release "Momentary Load" button.
13. If output was low (more than 5 amps below manufacturer's specs) proceed with
 - Charging system "Voltage Drop" test as suggested on page 16. If "Voltage Drop" values are within permissible limits proceed with
 - Alternator Output Test W/O Regulator under "b" below.
14. Stop Engine.

b. **ALTERNATOR OUTPUT TEST W/O REGULATOR**
 Proceed with this test if "Alternator Output Test with Regulator" did not meet the output specification given.
 Check condition and tension of alternator belt. Follow steps:
 1-7 as under "a" above for "Alternator/Voltage
 8. Regulator Output Test".
 8. Take the regulator out of the system by using the 304 or 342 Full Fielder Alternator Adapters (See Fig. 7 & 8).
 9. Discharge battery by applying about 100 AMP load with the Carbon Pile for 15 seconds. Push "Momentary Load" button, turn "Load Control" CW until "AMPS" reading shows desired load release "Momentary Load" button and push "15 Second Load" button.

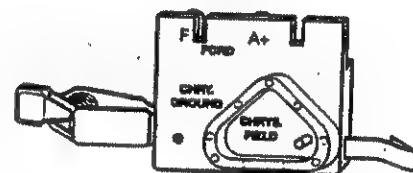
304



Full-Fielder
Alternator Test Adapter

Fig. 7

342



Full-Fielder II
Alternator Test Adapter

Fig. 8

10. Start the engine and maintain in IDLE.

CAUTION: By "Jumping" the field WITHOUT the regulator, the voltage output of the alternator is controlled by the rpm of the engine. DO NOT run engine above IDLE except when the Volts and Amps readings can be observed on the Analyzer.

11. While observing the voltage readings on the Analyzer, SLOWLY increase rpm of engine until specified voltage limit is reached.

Check output in amps.

— If output in Amps meets the alternator ratings or manufacturer's spec - Regulator is defective.
— If output of Alternator is insufficient - Alternator or both Alternator and Regulator are defective.

12. Stop engine and immediately disconnect "Full Fielder" Adapter.

c. GENERATOR/REGULATOR VOLT & CUT-OUT RELAY TEST

Analyzer connections and adjustments for Generator/Regulator Testing are the same as listed under steps:

1-5 — of "Alternator/Voltage Regulator Output Test" on page 12.

6. Connect "External volt leads" to Regulator as follows:

- Red lead to "BAT" terminal
- Black lead to GEN or ARM terminal

7. Push ON/OFF button to "ON".

8. Adjust Ammeter reading with "Zero Adjust" control to "0.000".

9. Connect "Amp Clamp-on" to either the positive (car's electrical installation) or negative (car's ground cable strap) battery cable, observing that the clamp-on is connected with the arrow on the clamp pointing to the respective positive or negative terminal of the battery.

10. Start engine and increase engine speed to 2000 rpm.

11. Observe volt reading. The regulator must control voltage between 13.8 and 15.5 volts in a 12 volt system.

12. Switch Volt Selector switch to "External Volts".

13. Reduce speed to fast idle (all lights and accessories must be off and doors closed). Volts reading should drop to "0".

14. Stop engine. Volts reading should show battery volts.

NOTE: Steps 13 and 14 check the "Cutout Relay" action while engine is:

1. in fast idle. A battery volts reading indicates that Cut-out Relay points have not yet closed.
2. stopped. A lower than normal battery volt reading indicates that Cut-out Relay points are stuck closed.

3. Adjust Cut-out Relay spring tension or replace Regulator.

d. GENERATOR/VOLTAGE REGULATOR OUTPUT TEST

Analyzer connections and adjustments are the same as listed under steps:

1-8 of "Alternator/Voltage Regulator Output Test" under "a" on page 12

9. Push "Momentary Load" button and turn "Load Control" CW (clockwise) until the voltage reading is 12 volts in a 12 volt system.

10. Observe "AMPS" reading and compare with manufacturer specs. Readings within +/- 5 amps is O.K.

11. Release "Momentary Load" button.

12. If "Output Reading" was:

HIGH....check Relay setting and generator field circuit.

LOW....make "Voltage Drop" test as suggested on page 16 and/or Generator Output Test w/o Regulator below.

ZERO....make Generator Output Test w/o Regulator below.

13. Stop engine.

e. GENERATOR OUTPUT TEST W/O REGULATOR

Analyzer and connection are the same as listed under the steps:

1-7 of "Alternator/Voltage Regulator Output Test" under "a" on page 12.

8. Disconnect Field Terminal at Regulator. Use a "jumper lead" to make connections as shown in Fig. 9 below.

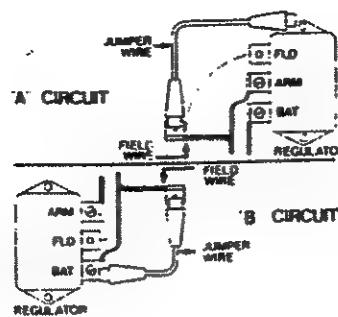


Fig. 9

There are two types of circuits that supply the current to the generator fields. One is called the "A" circuit and the other the "B" circuit. Most General Motors cars are "A" circuit. ground the field terminal. If it's a "B" circuit, connect a jumper wire from the armature terminal to the field terminal. If you can't remember which circuit your generator has, try grounding the field terminal first and then try it with the jumper between armature and field. With the correct field connector, run the engine to see if the generator will put out. Because you have an uncontrolled generator, you must not run the engine too fast or the generator will put out excessive current.

9. Discharge battery by applying about 100 Amp Load with the Carbon Pile for about 15 seconds. Push "Momentary Load" button, turn "Load Control" CW until "AMPS" reading shows desired load, release "Momentary Load" button and push "15 Second Load" button.
10. Start engine and hold at IDLE.
11. While observing voltage reading on Analyzer, SLOWLY increase rpm of engine until specified voltage limit is reached. Check output in Amps.
 - If the output meets the manufacturer's specs - Regulator is defective.
 - If the output is low or zero - Generator or both Generator and Regulator are defective.

G. VOLTAGE DROP TEST

1. PRELIMINARY INFORMATION

"Voltage drop" measurement can be very conveniently used to establish the voltage loss (due to resistance in a wire, cable, solenoid, harness, etc.) in an electric circuit while current is flowing from one point or connection to the other at the time. When using an Ohmmeter it is essential that the circuit under test be disconnected or isolated from any power source.

a. ANALYZER CONNECTION

By using the "Voltage Drop" approach it is much easier to pinpoint the existing problem, since tests can be performed with the circuit as is. It frequently happens that by removing or disconnecting something, the cause of the problem is eliminated, leaving doubts if the existing malfunction was corrected or not.

1. ON/OFF button must be in "OFF".
2. Turn "Load Control" knob fully CCW (counterclockwise).
3. Connect "Battery Cables" to battery as shown in Fig. 10 below.
4. Turn Volt Lead selector to "External Volts".
5. Push ON/OFF button to "ON".

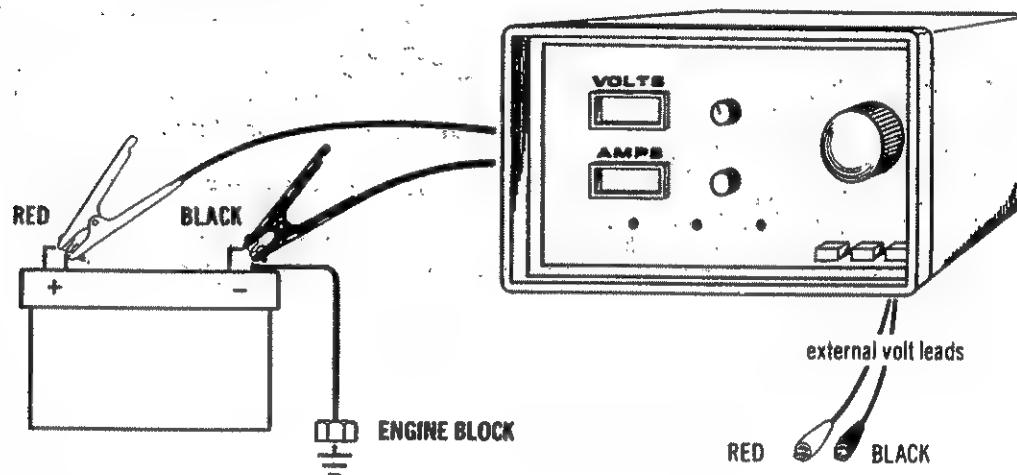


Figure 10

b. STARTING SYSTEM VOLTAGE DROP TESTS

6. Prevent Engine from starting by:
 - a. Disconnecting the high tension wire from the center tower of the distributor and connect to ground, or
 - b. disconnect the ignition switch lead from the primary terminal of the coil
7. Connect external volt leads to the starting circuit to be tested. See step by step procedure in Fig. 17 and test values in Table 3, page 18.
8. While cranking observe voltmeter reading.
- If "Voltage Drop Reading" is higher than values given for any specific circuit or component, replace or eliminate source of high resistance.
9. Reconnect wires to the distributor or coil.

STARTING SYSTEMS

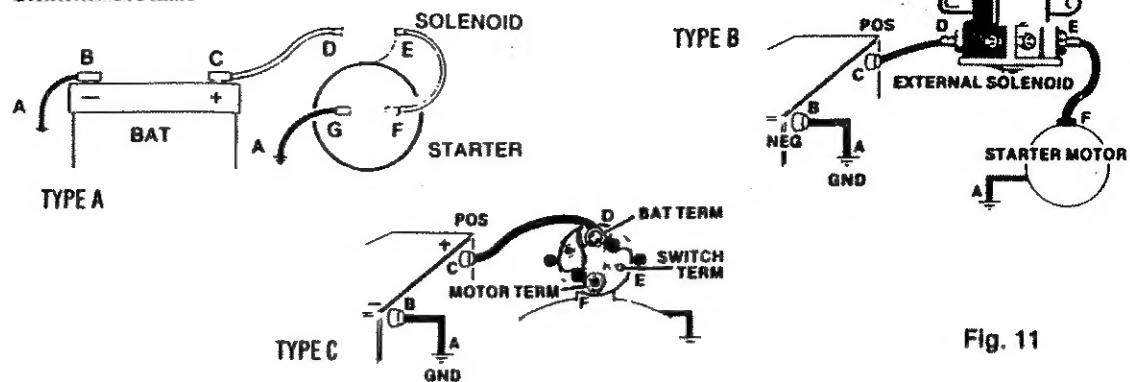


Fig. 11

c. CHARGING SYSTEM VOLTAGE DROP TESTS

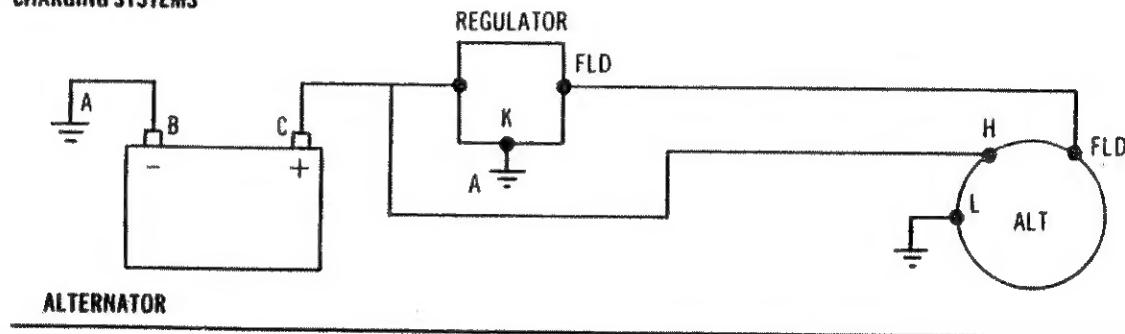
Leave Analyzer connected as per steps:

1-5 for "Starting System Voltage Drop Test"

6. Start engine and speed-up to 2000 rpm and hold.

7. Connect "External Volt Leads" to charging circuit to be tested following the step by step procedure indicated in Fig. 12 below and check against test values in Table 3 page 18.

CHARGING SYSTEMS



GENERATOR

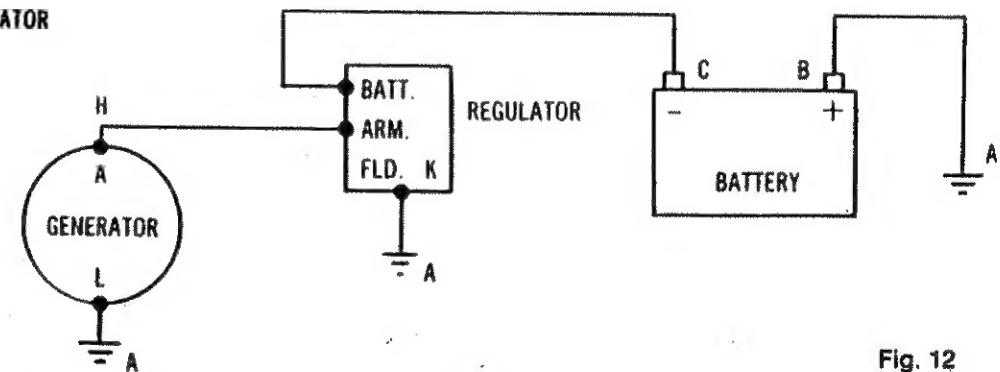


Fig. 12

TABLE 3 - VOLTAGE DROP VALUES - 12 VOLTS

TEST STEP	PART BEING TESTED	VOLT CLIP CONN. RED TO	VOLT CLIP CONN. BLK TO	MAXIMUM DROP	COMMENTS
A-B	NEG. BATT. TO GRD. CABLE	A	B	.2 VOLT	ALL SYSTEMS
C-D	POS. BATT. TO SOLEN. BATT. SIDE	C	D	.2 VOLT	STARTING SYST.
D-E	SOLEN. BATT. TO SOLEN. STARTER SIDE	D	E	.5 VOLT	STARTING SYST.
C-E	POS. BATT. TO SOLEN. STARTER SIDE	C	E	.6 VOLT	STARTING SYST.
E-F	BETWEEN STARTER AND SOLENOID	E	F	.2 VOLT	STARTING SYST.
G-A	STARTER TO GROUND	G	A	.2 VOLT	STARTING SYST.
C-H	INSULATED SIDE OF CHARGING CIRCUIT - ALT. AND GEN.	H	C	.5 VOLT 1.0 VOLT	W/INDICATOR LIGHT W/AMMETER
L-B	GROUND SIDE OF CHARGING CIRCUIT - ALT. AND GEN.	B	L	.2 VOLT	CHARGING SYSTEM
K-L	ALTERNATOR/GENERATOR AND REGULATOR GRD. CIRC.	K	L	.2 VOLT	CHARGING SYSTEM

H. 6 AND 24 VOLT TEST APPLICATIONS

The Analyzers will test 6 and 24 volt Starting and Charging Systems, even though it is specifically designed for 12 volt testing.

The connections and functions of the analyzer will be but with few exceptions the same, as when testing 12 volt systems. Following is a list of functional differences when using the analyzer for:

1. 6 VOLT SYSTEM TESTING CHANGES

a. AFFECTING THE ANALYZER'S FUNCTION

- LCD read-out and all other operational functions are not affected by the lower supply voltage until it drops below 4.5 volts.
- The "Charge & Retest" light will come on because all voltage readings when using the "15 Second Load" button function will be less than 9.6 volts. Just disregard the function of it.

b. AFFECTING THE TESTING PROCEDURE

- Battery Temperature/Voltage values will be different, see the applicable values given in Table 4 page 19.
- When performing "Battery Load or Capacity Tests" use Table 5 on page 19 as the applicable "Starting System Trouble Shooting" guide.
- When performing "Alternator/Regulator Output Tests" (Section F.2.a.) or "Generator/Regulator Output Tests" (Section F.2.d.) Step 9 should say:

Push "Momentary Load" button and turn "Load Control" CW until the voltage reading is 6 volt, in a 6 volt system.

- When making "Voltage Drop Tests" maximum voltage drop value should not exceed HALF (1/2), the values given in Table 3 on page 18 for a 12 volt system.

TABLE 4 - 6 OR 24 VOLT BATTERY TEMPERATURE/VOLTAGE VAL.

BATTERY TEMPERATURE									
SYSTEM VOLTAGE	ABOVE 70° F (21° C)	00° F 15° C	50° F 10° C	40° F 40° C	30° F -1° C	20° F -1° C	10° F -12° C	0° F -18° C	
6 VOLT	4.8	4.75	4.7	4.6	4.5	4.4	4.3	4.2	
24 VOLT	19.0	18.8	18.6	18.4	18.0	17.6	17.2	16.8	

TABLE 5 - STARTING SYSTEM TROUBLE SHOOTING CHART - 6 & 24 VOLT SYSTEMS
STARTING SYSTEM TEST RESULTS

6 VOLTS	24 VOLTS	AMPS	SPEED	PROBABLE CAUSES	SUGGESTIONS SOLUTIONS
ABOVE 4.8V	ABOVE 19.0V	NORMAL	NORMAL	STARTING SYST. GOOD COND.	
ABOVE 4.8V	ABOVE 19.0V	LOW	SLOW	-HIGH RESIST. -PARTIALLY BROKEN CABLES, WIRES -BAD SOLENOID -BAD GROUND	-VOLTAGE DROP TEST-PAGE 16 -CHECK BATT. CABLES, TERMINALS -SOLEN. CONTACTS -BY-PASS CIRC.
ABOVE 4.8V (HIGH)	ABOVE 19.0V (HIGH)	LOW	NORMAL (TO HIGH)	-ENGINE COMPRESSION LOW	-CYL. BAL. TEST -COMPR. TEST
BELOW 4.8V	BELOW 19.0V	NORMAL-TO LOW	SLOW-NORMAL	-DISCH. BATTERY -BAD BATTERY	-BATT. LOAD TEST -CHARGE & RET. -CHECK CHARG'G SYSTEM -AMBIENT TEMP. (LESS THAN 70° F (21° C)
BELOW 4.8V	BELOW 19.0V	NORMAL-TO HIGH	SLOW	-COLD OR OVER HEATED ENGINE -STARTER PROBLEM	-ALLOW ENGINE TO NORMALIZE -CHECK STARTER
BELOW 4.8V	BELOW 19.0V	NORMAL-TO HIGH	FLUCTUATING	-STARTER BAD -UNBALANCED ENGINE	-CHECK STARTER -CYL. BAL. TEST ENGINE
BELOW 4.8V	BELOW 19.0V	LOW	NO STARTER SOLENOID CLICKS	-OXIDIZED BATT. TERMINAL/POSTS	-CLEAN/SCRAPE POSTS/TERM.

2. 24 VOLT SYSTEM TESTING CHANGES:

**NOTE: DO NOT EXCEED 208 AMPS WHEN USING THE CARBON PILE TO LOAD A 24 VOLT SYSTEM.
12 VOLT BATTERIES CONNECTED IN SERIES SHOULD BE TESTED INDIVIDUALLY.**

a. AFFECTING THE ANALYZER'S FUNCTION

— "The Charge & Retest" light should not light when testing 24 volt systems, since the voltage should never drop below 9.6 volts.

b. AFFECTING THE TESTING PROCEDURE:

— "Battery Temperature/Voltage" value will be different. See applicable values given in Table 4 on page 19.

— When performing "Battery Load or Capacity Tests" use Table 5 on page 19, as the applicable "Starting System Trouble Shooting" guide.

— When performing "Alternator Regulator Output Tests" (Section F.2.a.) or "Generator/Regulator Output Tests" (Section F.2.d.) step 9 should say:

Push "Momentary Load" button and turn "Load Control" CW until the voltage reading is 24 volts in a 24 volt system.

— When making "Voltage Drop Tests", check manufacturer's specifications otherwise maximum voltage drop should not exceed one and a half (1½) times the value given in Table 3 page 18, for 12 volt systems.

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DIGITAL ELECTRICAL SYSTEM ANALYZER

OPTIONAL STANDS

If you have purchased your analyzer without a stand, and would like to obtain one, contact your supplier for more information.

REPLACEMENT PARTS

Instruction Manual	2-213701
Current Probe (Amp Clamp)	01 98726
Analyzer Dust Cover	400-1454
Multi purpose Full Fielding Adapter (304)	600-512
Chrysler External Elect. Regulator Full Fielding Adapter (342)	600-513
Side Terminal Battery Adapter	60 9605

Replacement parts are available from the factory. Write or call:

Kal Equip Company
10011 Walford Ave.
Cleveland, OH 44102

(216) 651-2233 Ask for the replacement parts department.